

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

2 Kinematics in one dimension

Exercise C, Question 15

Question:

A small canister is attached to a helium-filled balloon and released from rest at ground level. After 4 seconds it is moving vertically upwards at 6 m s^{-1} .

(a) Find the height of the balloon and canister after 4 seconds, stating clearly any assumptions that you make. When the balloon reaches a height of 27 m it bursts.

(b) Find the maximum height reached by the canister. [A]

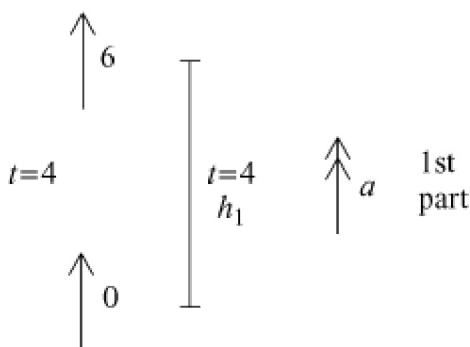
Solution:

(a) Assume the acceleration is constant

$$s = \frac{(u+v)}{2} \cdot t$$

$$h_1 = \frac{(0+6)}{2} \times 4$$

$$h_1 = 12 \text{ metres}$$



In 1st part, $v = u + at$

$$6 = 0 + a \times 4$$

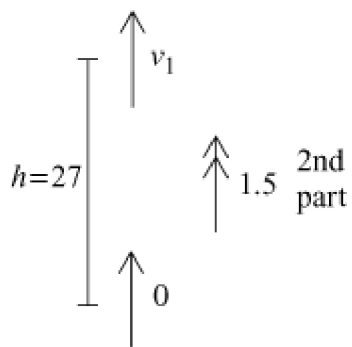
$$\therefore a = \frac{6}{4} = 1.5 \text{ m s}^{-2} \text{ is the acceleration}$$

(b) In 2nd part, $v^2 = u^2 + 2as$

$$v_1^2 = 0^2 + 2(1.5)(27)$$

$$\text{i.e. } v_1^2 = 81$$

$$\therefore v_1 = \sqrt{81} = 9 \text{ m s}^{-1} \text{ is the speed of the canister when the balloon bursts.}$$



$$\begin{aligned}
 \text{In 3rd part, } v^2 &= u^2 + 2as \\
 0^2 &= 9^2 + 2(-9.8)(h_2) \\
 \therefore 19.6h_2 &= 81 \\
 h_2 &= \frac{81}{19.6} \\
 &= 4.1326\dots \text{ m} \\
 \therefore \text{ maximum height} &= 27 + h_2 = 27 + 4.1326\dots \\
 &= 31.1326\dots \\
 &= 31.1 \text{ m (3 s.f.)}
 \end{aligned}$$

